APPENDIX G

Congestion Analysis for Corridor Plans

An important element of a corridor plan is to accurately assess the current and future congestion within the corridor based on current and forecast traffic and conditions. The content and format of the corridor plan should enable the reader to clearly understand:

- The methodology used to analyze roadway congestion;
- The actual and assumed input data used in the analysis;
- The results of the analysis for both the current and future conditions.

The purpose for this paper is to discuss and offer recommendations for standardizing the way in which congestion is analyzed and reported in conjunction with ITD's corridor plans. Specific sections to address this purpose are as follows:

1. Congestion analysis procedures
   a. Two-lane unsignalized roads
   b. Multi-lane unsignalized roads
   c. Signalized roads
   d. Freeways
   e. HPMS congestion analysis

2. Input data
   a. Data items needed
   b. Current data sources
   c. Data compiling and reporting

3. Analysis results

4. Comments and recommendations

<u>Congestion Analysis Procedures:</u>

The nationally accepted procedures for highway capacity and congestion analysis are detailed in the Transportation Research Board's (TRB's) Highway Capacity Manual. The current edition of this manual (HCM2000) provides comprehensive procedures and explanations for assessing roadway congestion on facilities ranging from 2-lane rural roads to 10+ lane urban freeways.

The assessment of congestion is presented in terms of a variety of performance measures and most notably Level of Service (LOS) which is the most commonly used and understood index for congestion.

With respect to the issue of applying the HCM2000 to corridor studies, it should be noted that the manual provides several chapters addressing corridor level analysis. Unfortunately, these procedures address a somewhat different concept of corridors than is commonly examined in Idaho’s corridor plans. Specifically, the HCM2000 defines a corridor as “a set of essentially parallel and competing facilities and modes with cross-connectors that serve trips between two designated points”. As such, the HCM2000 corridor might best be described as a multi-modal network and, therefore, application of the HCM2000 guidance for congestion analysis of corridors and areas, as detailed in Chapters 28-30, should be limited to extensive system and network situations. For the above reason, facility level rather than corridor level techniques from the HCM2000 will most often be appropriate for congestion analyses in conjunction with Idaho’s corridor plans.

Specific guidance on facility level analyses for the facility types most likely to be found in conjunction with Idaho’s corridor plans are detailed below.

Two-lane Uninterrupted Flow Procedures (Chapter 20, HCM2000):

The two-lane highway procedures detailed in Chapter 20 of the HCM2000 are used to calculate the Level of Service (LOS) for two-lane rural and suburban highways with “uninterrupted flow traffic” (i.e. no signals or other stop controls closer than two miles apart and no traffic impacts due to parking, buses or pedestrians).

The HCM2000 provides both operational procedures for analysis of current conditions (for which much is known about the traffic conditions) and planning procedures for analysis of future conditions (for which some input data items can be estimated while the rest must be assumed).

For both operational and planning level analyses, the maximum theoretical capacity of a two-lane rural roadway (assuming ideal geometrics, terrain and traffic characteristics) is assumed to be 1700 pc/h for each direction of travel or 3200 pc/h for both directions of travel. The LOS in either direction of a two-lane roadway is, in part, influenced by the traffic flow in the opposing direction because of the effect it will have on passing opportunities.

Inputs to the two-lane highway LOS analysis include:

Annual average daily traffic, AADT (veh/day)
K factor (proportion of AADT occurring in peak hour)
Peak hour factor, PHF (peak hourly flow/peak 15 minute flow)
Length of analysis period (15 minutes)
Directional split, D (proportion of peak-hour traffic in peak direction)
Percent trucks, buses, and RVs, P (%)

Base free flow speed, BFFS (free flow speed representative of a roadways traffic and alignment)
Percent no-passing zones (%)
Lane and shoulder widths (ft)
Access points per mile
Terrain

The operational analysis procedures first employ a series of calculations to estimate the affect of the above input parameters on traffic flow. The cumulative affect of the input parameters is next used to estimate the percent time spent following and average travel speed for the segment in question. The LOS is then determined using an established criteria for percent time following and average travel speed (for class I highways). The described analysis can be applied either for a two-way traffic flow analysis or a one-way directional traffic flow analysis.

The planning level analysis essentially consists of using the same procedures as set forth for an operational level analysis but using assumed values for the input parameters where needed such as follows:

Directional split = 60/40	ref. HCM2000, Exhibit 12-13
Lane and shoulder widths = 12 and 6 feet	ref. HCM2000, Exhibit 12-9
K Factor = Varies by area type	ref. HCM2000, Exhibit 8-9
Peak hour factor = 0.88 (rural), 0.92 (urban)	ref. HCM2000, Exhibit 12-9
Length of analysis period = 15 min.	ref. HCM2000, Exhibit 12-9
Percent trucks = 14% (rural), 2% (urban)	ref. HCM2000, Exhibit 12-14
Percent RVs = 4% (rural), 0% (urban)	ref. HCM2000, Exhibit 12-14
Percent no passing = 20% (level), 50% (rolling) or 80% (mts.)	ref. HCM2000, Exhibit 12-11
Access points per mile = 8 (rural), 16 (suburb low density), 25 (suburb high density)	ref. HCM2000, Exhibit 12-4
Terrain = Level	ref. HCM2000, Exhibit 12-9

The planning approach can be further simplified by constructing tables such as that illustrated with Exhibit 12-15 of the HCM2000 (See Attachment A).

Occasionally, there is a need to analyze directional specific levels of service; particularly for extended grades, and segments with passing lanes. Methodologies for these unique situations have been developed and are presented in HCM2000, Chapter 20. Application of these special case methodologies for corridor plans should be reserved for situations in which such analyses have been specifically requested.

Multi-Lane Uninterrupted Flow Procedures (Chapter 21, HCM2000):

The multi-lane highway procedures detailed in Chapter 21 of the HCM2000 are used to calculate the LOS for multi-lane (4+ lane) rural and suburban highways with “uninterrupted flow traffic” (i.e. no signals or other stop controls closer than two miles apart and no traffic impacts due to parking, buses or pedestrians).

The HCM2000 provides both operational procedures for analysis of current conditions (for which much is known about the traffic conditions) and planning procedures (for analysis of future conditions for which some input data items can be estimated while the rest must be assumed).

For both operational and planning level analyses, the maximum theoretical capacity of a multi-lane roadway (assuming ideal geometrics, terrain, and traffic characteristics) is 2200 pc/hr/ln. Because multi-lane roadways allow for vehicles to pass without moving into opposing traffic lanes, the corresponding capacity analysis technique does not explicitly consider opposing traffic conditions.

Inputs for multi-lane highway LOS analysis include:

Average annual daily traffic, AADT (veh/day)
Number of lanes, N
K factor (proportion of AADT occurring in peak hour)
Peak hour factor, PHF (peak hourly flow/peak 15 minute flow)
Length of analysis period
Directional split, D (proportion of peak-hour traffic in peak direction)
Driver population factor (weekend recreational traffic influence)
Percent trucks, buses, and RVs, P (%)
Free flow speed, FFS (mi/hr)
Percent no-passing zones (%)
Lane width (ft)
Median width (ft)
Lateral clearance (ft)
Access points per mile
Terrain

The operational analysis procedures employ a series of calculations to estimate the affect of the input parameters on traffic flow. The cumulative affect of the input parameters is next used to estimate the flow rate (in passenger cars per hour per lane), free flow speed (miles per hour), and density (passenger cars per mile per hour) for the segment in question. The LOS is then determined based on an established relationship to traffic density. Owing to the relatively independent nature of traffic in opposing directions on multi-lane highways, this analysis is applied only to one (typically peak) direction.

The planning level analysis for multi-lane highways consists of using the same procedures as set forth for an operational level analysis but using assumed values for the input data items where needed such as follows:

K Factor = Varies by area type	ref. HCM2000, Exhibit 8-9
Peak hour factor = 0.88 rural, 0.92 urban	ref. HCM2000, Exhibit 12-3
Length of analysis period = 15 min.	ref. HCM2000, Exhibit 12-3
Percent trucks and buses = 10% rural, 5% urban	ref. HCM2000, Exhibit 12-3
Lanes = 12 feet	ref. HCM2000, Exhibit 12-3

Lateral Clearance = 6 feet	ref. HCM2000, Exhibit 12-3
Access points per mile = 8 (rural), 16 (suburb low density), 25 (suburb high density)	ref. HCM2000, Exhibit 12-4
Driver population factor = 1.0	ref. HCM2000, Exhibit 12-3
Terrain = Level	ref. HCM2000, Exhibit 12-3
Base Free Flow Speed = 60 mi/hr	ref. HCM2000, Exhibit 12-3

The planning process can be further simplified by constructing tables such as that illustrated with Exhibit 12-5 of the HCM2000 (See Attachment A).

Signalized Roadway Procedures (Chapter 15, HCM2000):

The roadways to be considered under this process are categorized as urban streets and are meant to include streets controlled by traffic signals at a spacing of two miles or less (such as might typically be found in an urban setting). The focus of the analysis is on assessing mobility rather than access and, with that, the analysis looks at roadway segments of at least two miles in length (as opposed to individual intersections). One notable simplification applied in these procedures versus those of for individual signalized intersections detailed in Chapter 16 of HCM2000 is the assumption that left turn volumes are fully accommodated by existing turn bays.

The HCM2000 provides both operational procedures for analysis of current conditions (for which much is known about the traffic conditions) and planning procedures for analysis of future conditions (for which some input data items can be estimated while the rest must be assumed).

The LOS for urban streets is based on average through-vehicle travel speed for the segment or for the entire street under consideration with travel speed being the basic service measure used. The level of service is influenced both by the number of signals per mile and by the intersection control delay (the portion of the total delay for a vehicle approaching and entering a signalized intersection that is attributable to traffic signal operation).

The input values for urban street analysis include:

Average annual daily traffic, AADT (veh/day)
Number of lanes, N
K factor (proportion of AADT occurring in peak hour)
Peak hour factor, PHF (peak hourly flow/peak 15 minute flow)
Percent Heavy Vehicles, (%)
Directional split, D (proportion of peak-hour traffic in peak direction)
Adjusted saturation flow, s (veh/hr/ln)
Percent left turns, Plt (%)
Free flow speed, FFS (mi/hr)
Running time, Tr (sec)
Initial queue, Qb (sec)
Effective green time for lane group(s), g (sec.)
Cycle length, C (sec)

Arrival type, AT
Signalization type
Actuated Control Adjustment Factor, k
Upstream filtering/metering adjustment factor, I
Initial queue delay, d (sec)
Analysis period, T (hrs)
Urban street class, Sc
Segment length, L (miles)
Signal density (signals/mi)
Grade, %

The operational level analysis procedures employ a series of calculations to estimate the affect of the above input parameters on traffic flow and delay. Next, using the above results, the travel time and speed for each roadway segment and the entire roadway are determined. Then the LOS for each segment and the full roadway are determined based on an established relationship with average travel speed for the various roadway classes.

The planning level analysis essentially consists of using the same procedures as set forth for an operational level analysis but using assumed values for the input data items where needed such as follows:

K Factor = Varies by area type	ref. HCM2000, Exhibit 8-9
Peak hour factor = 0.88 (uniform flow), 0.92 (congested flow)	ref. HCM2000, Page 10-8
Length of analysis period = 15 min.	ref. HCM2000, Exhibit 10-12
Percent Heavy Vehicles = 2%	ref. HCM2000, Exhibit 10-12
Adjusted saturation flow = 1700 pc/hr/ln CBD 1800 pc/hr/ln other	ref. HCM2000, Exhibit 10-12
Percent left turns = 10%	ref. HCM2000, Exhibit 10-7
Free flow speed = Varies by roadway class	ref. HCM2000, Exhibit 10-5 and Exhibit15-2
Running time = Varies by roadway class and length	ref. HCM2000, Exhibit 15-3
Initial queue = 0	ref. HCM2000, Exhibit F16-4
Effective green time for lane group(s) = 0.45	ref. HCM2000, Exhibit 10-7
Cycle length = Varies by roadway class	ref. HCM2000, Exhibit 10-7
Arrival type = 3 (uncoordinated), 4 (coordinated)	ref. HCM2000, Exhibit 10-12
Signalization type = Actuated	ref. HCM2000, Exhibit 10-12
Actuated Control Adjustment Factor = 0.40	ref. HCM2000, Exhibit 10-12
Upstream filtering/metering adjustment factor =1.0	ref. HCM2000, Exhibit 10-12
Analysis period = 0.25 hour	ref. HCM2000, Exhibit 10-12
Urban street class = Varies	ref. HCM2000, Exhibit 10-3 and Exhibit 10-4
Signal density = Varies by roadway class	ref. HCM2000, Exhibit 10-6
Grade = 0%	ref. HCM2000, Exhibit 10-12

The planning procedures can be further simplified by constructing tables such as that illustrated with Exhibit 10-7 of the HCM2000 (See Attachment A).

Freeway Facilities Procedures (Chapter 23-25, HCM2000):

The freeway facility procedures detailed in Chapters 23 of the HCM2000 are designed to establish the LOS of basic freeway segments with fully controlled access and "uninterrupted flow traffic" (i.e. no signals or other stop controls). The freeway procedures detailed in Chapters 24 and 25 of the HCM2000 address freeway weaving and ramp segments respectively.

The HCM2000 provides both operational procedures for analysis of current conditions (for which much is known about the traffic conditions) and planning procedures for analysis of future conditions (for which some input data items can be estimated while the rest must be assumed).

For both operational and planning level analyses, the maximum theoretical capacity of freeways (assuming ideal geometrics, terrain, and traffic characteristics) is 2,400 passenger cars per hour per lane.

The input values for the freeway analysis include:

Average annual daily traffic, AADT (veh/day)
Number of lanes, N
K factor (proportion of AADT occurring in peak hour)
Peak hour factor, PHF (peak hourly flow/peak 15 minute flow)
Length of analysis period
Directional split, D (proportion of peak-hour traffic in peak direction)
Driver population factor (weekend recreational traffic influence)
Percent trucks, buses, and RVs, P (%)
Free flow speed, FFS (mi/hr)
Percent no-passing zones (%)
Lane and shoulder widths (ft)
Terrain
Interchange density (#/mi)

The operational analysis procedures employ a series of calculations to estimate the affect of the input parameters on traffic flow. The cumulative affect of the input parameters is next used to estimate the flow rate (passenger cars per hour per lane), free flow speed (miles per hour), and density (passenger cars per mile per hour). The LOS is then determined based on an established relationship to traffic density. Owing to the relatively independent nature of traffic in opposing directions on freeways, this analysis is applied only to one (typically peak) direction.

The planning level analysis for freeways consists of using the same procedures as set forth for an operational level analysis but using assumed values for the input data items where needed such as follows:

K Factor = Varies by area type	ref. HCM2000, Exhibit 8-9
Peak hour factor = 0.88 rural, 0.92 urban	ref. HCM2000, Exhibit 13.5
Length of analysis period = 15 min.	ref. HCM2000, Exhibit 13.5
Percent trucks and buses = 10% rural, 5% urban	ref. HCM2000, Exhibit 13.5

Lanes = 12 feet	ref. HCM2000, Exhibit 13.5
Lateral Clearance = 10 feet	ref. HCM2000, Exhibit 13.5
Terrain = Level	ref. HCM2000, Exhibit 13.5
Base Free Flow Speed = 75 mi/hr (rural), 70 mi/hr (urban)	ref. HCM2000, Exhibit 13.5
Driver Population Factor = 1.0	ref. HCM2000, Exhibit 13.5
Length of Analysis Period = 15 min	ref. HCM2000, Exhibit 13.5
Interchange density = 0.5/mi rural, 1/mi urban	ref. HCM2000, Pg 13-11 and Exhibit 13-6

As with the basic freeway sections, the analysis of weaving and ramp sections involves first using a series of calculations to estimate the affect of the input parameters on traffic flow. This information is then used to establish the flow rates, free flow speeds and densities of traffic for the various traffic movements in the weaving and ramp segments. The level of service for these segments is then determined based on an established relationship to traffic density.

Analysis of freeway LOS in conjunction with corridor studies should specifically address weaving and ramp segments as a matter of practice. Current and forecast traffic data for the various movements of weave and ramp sections will need to be coordinated with ITD.

The planning level analysis process can be further simplified by constructing tables for basic freeway segments, weaving segments and ramps as illustrated in Exhibits 13-6, 13-13 and 13-20 respectively (See Attachment A).

HPMS Congestion Analysis:

An adaptation of the HCM2000 procedures for congestion analysis has recently been developed by the FHWA for use in conjunction with its Highway Performance Monitoring System (HPMS) Program. This process uses the existing data from the HPMS database along with a series of simplifications to the HCM2000 process, including assumptions and default values, to generate capacity estimates for inventoried roadway sections. The generated capacity values are, in turn, used in conjunction with current traffic data to arrive at the V/C ratio (volume over capacity) performance measure.

Obvious advantages to the HPMS process include the facts that it utilizes existing, inventoried data and that it is automated and therefore requires only collection of the input data.

Limitations to the HPMS process include:

1. The inevitable compromises to accuracy introduced by using default values, assumptions and simplified formulas.

2. The use of V/C as the resultant performance measure rather than the more widely understood LOS measure.

3. The likely need for carrying out the analysis within the HPMS program and statewide database. In other words, the program is not designed to be run as a separate utility package for performing congestion analyses of individual corridors or projects.

Details concerning the HPMS congestion analysis process are available in Appendix N of FHWA's HPMS Field Manual (See Attachment B).

<u>Input Data:</u>

As detailed in the previous section, an extensive amount of data and/or default input parameter values are needed to conduct LOS analyses of roadway sections.

Clear guidance on the input data to be used and identification of the sources for this data are as important to the evaluation process as the actual analysis steps. Specifically, those charged with conducting the analysis will need to know:

1. For which input parameters assumed and/or default values can be used and what these values should be.

2. For those input parameters using actual data, the source (such as contact person, web sites address, etc.) of such data.

3. Procedures or criteria to be applied for collecting or compiling data through field surveys or screening of existing databases.

The following tables list the input parameters needed to conduct congestion analyses using the HCM2000 procedures. Included in these tables are the parameters names, the proposed sources of data for these parameters, and, where applicable, recommended default values for each of the four highway types discussed in the previous section. In addition, for reference and comparison purposes, the tables also cite the HPMS data items or default values corresponding to each input parameter.

Two-Lane Uninterrupted Flow Highways				
Data Item	**Primary Source**	**Default Value(s)**	**HPMS Data Item/Value**	**Comments**
Volume (AADT)	ITD Traffic Survey and Analysis	None	Item 33	Current and forecast traffic volumes
Number of Lanes, N	ITD Planning Services Section	None	Item 34	
K Factor	ITD Traffic Survey and Analysis	HCM2000 Exhibit 8-9	Item 85	(back calculate from given AADT and Design Hour Volume???)
Peak Hour Factor, PHF	HCM2000	0.88 Rural 0.92 Urban HCM2000 Exhibit 12-9	Assume 0.88	
Length of analysis period	HCM2000	15 min. HCM2000 Exhibit 12-9	Assume 15 min.	
Directional Split, D	ITD Traffic Survey and Analysis	60/40 HCM2000 Exhibit 12-13	Item 86	
Percent Heavy Vehicles, P	ITD Traffic Survey and Analysis	14% Trucks, 4% RVs Rural 2% Trucks, 0% RVs Urban HCM2000 Exhibit 12-14	Item 82 + Item 84	
Base Free Flow Speed, BFFS	ITD Traffic Section	None	N/A	Estimated based on speed data and knowledge of local operating conditions
Percent No-Passing Zones	ITD Planning Services Section	20% (level), 50% (rolling), 80% (mts.) HCM2000 Exhibit 12-11	Item 78	
Lane Width	ITD Planning Services Section	Lanes = 12 Ft HCM2000 Exhibit 12-9	N/A	
Shoulder Width	ITD Planning Services Section	Shoulders = 6 Ft HCM2000 Exhibit 12-9	N/A	
Access Points	ITD Planning Services Section	8 (Rural), 16 (suburb, low density), and 25 (suburb, high density)	N/A	
Terrain	ITD Planning Services Section	Level HCM2000 Exhibit 12-9	Items 70-78	

Multi-Lane Uninterrupted Flow Highways				
Data Item	**Primary Source**	**Default Value(s)**	**HPMS Data Item/Value**	**Comments**
Volume (AADT)	ITD Traffic Survey and Analysis	None	Item 33	Current and forecast traffic volumes
Number of Lanes, N	ITD Planning Services Section	None	Item 87	
K Factor	ITD Traffic Survey and Analysis	HCM2000 Exhibit 8-9	Item 85	(back calculate from given AADT and Design Hour Volume???)
Peak Hour Factor, PHF	HCM2000	0.88 Rural 0.92 Urban HCM2000 Exhibit 12-3	0.88 to 0.95 depending on V/C (Items 33, 85, 86 and 95)	
Length of analysis period	HCM2000	15 min HCM2000 Exhibit 12-3	Assume 15 Minutes	
Directional Split, D	ITD Traffic Survey and Analysis	60/40 ITD Statewide Default	Item 86	
Driver Population Factor		1.0 HCM2000 Exhibit 12-3	Assume 1.0	
Percent Heavy Vehicles, P	ITD Traffic Survey and Analysis	10% Rural 5% Urban HCM2000 Exhibit 12-3	Item 81 + Item 83	
Base Free Flow Speed, BFFS	ITD Traffic Section	60 mph HCM2000 Exhibit 12-3	Item 80	Estimated based on speed data and knowledge of local operating conditions
Lanes Width	ITD Planning Services Section	Lanes = 12 Ft HCM2000 Exhibit 12-3	Item 54	
Shoulder Width	ITD Planning Services Section	Lateral Clearance = 6 Ft HCM2000 Exhibit 12-3	Items 59 and 60	Lateral clearance is sum of shoulder and median width per Exhibit 21-5
Median Width	ITD Planning Services Section	None	Items 56, 57 and 80	
Access Points	ITD Planning Services Section	8 (Rural), 16 (suburb, low density), and 25 (suburb, high density) HCM2000 Exhibit 12-4	Items 94 and 30	
Terrain	ITD Planning Services Section	Level HCM2000 Exhibit 12-3	Item 70	

Signalized Highways				
Data Item	**Primary Source**	**Default Value(s)**	**HPMS Data Item/Value**	**Comments**
Volume (AADT)	ITD Traffic Survey and Analysis	None	Item 33	Current and forecast traffic volumes
Number of Lanes, N	ITD Planning Services Section	None	Item 87	
K Factor	ITD Traffic Survey and Analysis	HCM2000 Exhibit 8-9	Item 85	(back calculate from given AADT and Design Hour Volume???)
Peak Hour Factor, PHF	HCM2000	0.92 (congested conditions) 0.88 (uniform flow through peak hour) HCM2000 Exhibit 10-12 and Page 10-8	Assume 0.88 rural, 0.92 urban	
Length of analysis period	HCM2000	15 min HCM2000 Exhibit 10-12	15 minutes	
Directional Split, D	ITD Traffic Survey and Analysis	60/40 ITD Statewide Default	Item 86	
Adjusted Saturation Flow, s		1700 pc/hr/ln CBD 1800 pc/hr/ln other HCM2000 Exhibit 10-19	Assume 1,900	
Percent Heavy Vehicles, P	ITD Traffic Survey and Analysis	2% HCM2000 Exhibit 10-12	Item 81 + Item 83	
Percent Left Turns	ITD Traffic Section	% Lt = 10% HCM2000 Exhibit 10-7	Assume 10% where protected phasing and shared left turns	
Free Flow Speed, FFS	ITD Traffic Section	Varies by roadway class HCM2000 Exhibit 10-5 and Exhibit 15-2	N/A	Estimated mid-block travel speed at low flow periods
Running Time	ITD Traffic Section	Varies by roadway class HCM2000 Exhibit 15-3	N/A	
Initial Queue		0 Sec HCM2000 Exhibit F16-4	N/A	
Effective Green Time	ITD Traffic Section	0.45 HCM2000 Exhibit 10-7	Item 91	
Cycle Length	ITD Traffic Section	Varies by roadway class HCM2000 10-7	N/A	

Signalized Highways				
Arrival Type	ITD Traffic Section	AT = 3 (uncoordinated) AT = 4 (coordinated) HCM2000 10-12	N/A	
Signalization Type	ITD Traffic Section	Actuated HCM2000 Exhibit 10-12	Item 90	
Actuated Control Adjustment Factor	ITD Traffic Section	K = 0.40 HCM2000 Exhibit 10-12	N/A	
Upstream Filtering/Metering Adjustment Factor	ITD Traffic Section	I = 1.00 HCM2000 Exhibit 10-12	N/A	
Urban Street Class		Varies HCM2000 Exhibit 10-3 and Exhibit 10-4	Item 17	
Signal Density	ITD Traffic Section	Varies by roadway class HCM2000 Exhibit 10-6	Item 92 and Item 30	
Lanes Width	ITD Planning Services Section	Lanes = 12 Ft HCM2000 Exhibit 10-12	Item 54	
Grade	ITD Planning Services Section	0 % HCM2000 Exhibit 10-12	Assume 0%	

* Note that HPMS Software analyzes sections using the signalized intersection procedures of the HCM2000 Chapter 16 rather than the urban streets procedures of Chapter 15.

Freeways				
Data Item	**Primary Source**	**Default Value(s)**	**HPMS Data Item/Value**	**Comments**
Volume (AADT)	ITD Traffic Survey and Analysis	None	Item 33	Current and forecast traffic volumes
Number of Lanes, N	ITD Planning Services Section	None	Item 34	
K Factor	ITD Traffic Survey and Analysis	HCM2000 Exhibit 8-9	Item 85	(back calculate from given AADT and Design Hour Volume)
Peak Hour Factor, PHF	HCM2000	0.88 Rural 0.92 Urban HCM2000 Exhibit 13-5	0.88 to 0.95 depending on V/C (Items 33, 85, 86 and 95)	
Length of analysis period	HCM2000	15 min HCM2000 Exhibit 13-5	15 min	
Directional Split, D	ITD Traffic Survey and Analysis	60/40 ITD Statewide Default	Item 86	
Driver Population Factor		1.0 HCM2000 Exhibit 13-5	1.0 urban, 0.975 rural	
Percent Heavy Vehicles, P	ITD Traffic Survey and Analysis	10% Rural 5% Urban HCM2000 Exhibit 13-5	Item 81 + Item 83	
Base Free Flow Speed, BFFS	ITD Traffic Section	75 mph rural, 70 mph urban HCM2000 Exhibit 13-5	70 urban, 75 rural	Estimated based on speed data and knowledge of local operating conditions
Lanes Width	ITD Planning Services Section	Lanes = 12 Ft HCM2000 Exhibit 13-5	Item 54	
Shoulder Width	ITD Planning Services Section	Lateral Clearance = 10 Ft Shoulder Width = 6 Ft HCM2000 Exhibit 13-5	Item 59	
Terrain	ITD Planning Services Section	Level HCM2000 Exhibit 13-5	Item 70	
Interchange Density	ITD Planning Services Section	0.5/mi rural 1.0/mi urban HCM2000 Exhibit 13-6	0.70/mi Small Urban Areas 0.76/mi Small Urbanized Areas 0.83/mi Large Urbanized Areas	

Documentation of the input data used in corridor plans is important for reference and verification purposes. Considering the substantial number of input variables needed to establish the LOS of a roadway section and the potential large number of roadway sections within a corridor, the presentation of input data will require some consideration on which data to present and how.

A suggested approach for input data documentation is to first create a table listing the parameters for which a single value will be used an entire corridor or roadway. A second table could then be prepared to present the remaining parameter values for each segment of the roadway (See examples, below).

CORRIDOR PLAN "XYZ"; RTE 99; ROADWAY-WIDE INPUT DATA VALUES FOR TWO-LANE ROADWAYS	
PARAMETER	**VALUE**
Peak Hour Factor (PHF)	.88
Length of Analysis Period	15 minutes
Directional Split (D)	60/40

CORRIDOR PLAN "XYZ"; RTE 99; INPUT VALUES BY SECTION FOR TWO-LANE ROADWAYS						
Data Item	00.0 – 02.0	02.1 – 04.3	04.4 – 08.2	08.3 – 10.0	10.1 – 16.0	16.1 – 17.0
2000 ADT	3,000	4,000	4,600	4,500	3,000	2,900
2025 ADT	3,500	4,600	5,000	5,000	3,400	3,200
# Lanes	2	3	3	3	2	2
K-Factor	.12	.10	.10	.10	.15	.15
% Trucks	2%	2%	2%	2%	4%	4%
BFFS	60	60	60	60	60	60
% No Pass	50%	0%	0%	0%	40%	60%
Lane Width	12	12	12	12	12	12
Shld Width	8	4	4	4	8	8
Acc. Pts.	8	4	4	4	8	8
Terrain	Flat	Rolling	Rolling	Rolling	Flat	Flat

For many corridors there will be a need for several sets of tables, as described above, to represent the various roadway types (two-lane, multi-lane, urban, and freeway) within the corridor, and therefore it may be advisable to present these numerous tables in the appendix of the corridor plan document.

Analysis Results:

For corridor plans, the primary measure to be used for evaluating congestion is Level of Service (LOS). For each roadway section under consideration, the LOS should be determined for the existing roadway based on both the current and forecast roadway volumes. The results of the evaluation will then serve as a basis for identifying current and future capacity needs.

Presentation of the analysis results can vary and may utilize tabular and/or graphical methods. An example of a tabular approach to presenting the data is illustrated below:

CORRIDOR PLAN "XYZ"; RTE 99; CURRENT AND FUTURE LEVEL OF SERVICE		
Section	2003 LOS	2025 LOS
00.0 – 02.0	C	D
02.1 – 04.3	C	D
04.4 – 08.2	C	D
08.3 – 10.0	C	D
10.1 – 16.0	D	D
16.1 – 17.0	C	D

Comments and Recommendations:

In consideration of the above information on congestion analysis for corridor plans, the following comments and recommendations are offered to facilitate standardization of ITD's procedures:

1. The facility level analysis procedures of the HCM2000 are recommended for congestion analysis purposes unless otherwise specified. Specifically, the procedures from following chapters of the HCM should be used for the following roadway types:
   a. Two-lane unsignalized roadways – Chapter 20
   b. Multi-lane uninterrupted flow roadways – Chapter 21
   c. Signalized roadways – Chapter 15
   d. Freeway facilities – Chapters 22-25

2. For the facility types discussed in this paper, the only notable distinction between an operational level analysis and a planning level analysis is the use of assumed and/or default values rather than actual data for a number of the input parameters.

3. Considering the planning-level nature of corridor plans and practical limitations in terms of available data in conjunction with 20 year horizon analyses, the procedures used for assessing congestion in these studies can best be described and planning level analyses.

4. HPMS generated measures of congestion in terms of V/C already exist for all roadway sections currently inventoried as standard sample sections in the HPMS

database. Remaining roadway sections (universe sample sections) could conceivably also be analyzed with the HPMS software if the necessary additional data for such sections was entered into the HPMS database.

5. Utilization of the HPMS software has some practical limitations including accuracy limitations, results in terms of V/C rather than LOS, and the need for familiarity with the HPMS software program in order to conduct the analysis.

6. Decisions concerning the standardization of default input data values need to be made and documented.

7. Decisions concerning the standardization input data sources need to be made and procedures established to afford consultants easy access to the data.

8. Consideration should be given for simplifying the analysis process by developing "look-up" tables such as those described above and illustrated in the HCM2000 (See Attachment A).

9. Guidance concerning the expectations for presenting input data and results in the corridor plan report needs to be developed and documented.

ATTACHMENT A

PLANNING LEVEL ANALYSIS “LOOK-UP” TABLES

ATTACHMENT B

HPMS PROCEDURES FOR ESTIMATING HIGHWAY CAPACITY